

Chondrule radius and evaporate fraction in viewpoint of shock-wave heating model

H. MIURA¹ AND T. NAKAMOTO²

¹Univ. of Tsukuba, Japan (miurah@rccp.tsukuba.ac.jp)

²Univ. of Tsukuba, Japan (nakamoto@rccp.tsukuba.ac.jp)

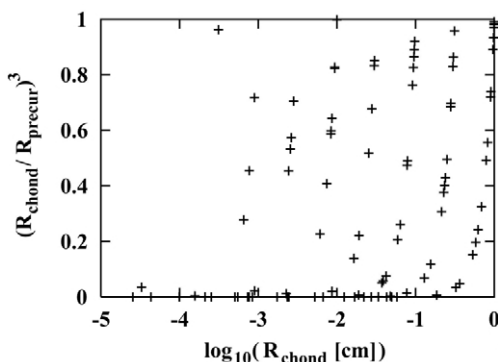
Shock-Wave Heating Model

The shock-wave heating model is one of the most possible mechanisms for chondrule formation. In this mechanism, formed chondrules in the postshock region are exposed by the hot gas in that region until the gas cools by emission of radiation. In this phase, most of small chondrules evaporate completely. On the other hand, some of larger ones shrink by the evaporation and survive to become the small chondrules (Miura & Nakamoto, 2003). From these results, it is naturally expected that the small chondrules have lost the greater portion of their initial mass than the large ones.

Numerical Results

We numerically simulated the chondrule formation by shock wave heating with various shock properties (shock velocity $v_s = 5 - 70 \text{ km s}^{-1}$ and preshock gas number density $n_0 = 10^{10} - 10^{15} \text{ cm}^{-3}$). Figure 1 shows the relation between the present chondrule radius and the evaporate fraction. In this study, as the indicator of evaporate fraction, we chose the volume ratio of the chondrule to its precursor. From Fig. 1, we can see that there are some chondrules which do not evaporate if their radii are larger than about 1 mm. However, chondrules whose radii are less than $100 \mu\text{m}$ ($10 \mu\text{m}$) must have lost their initial mass about 20% (40%) or more by the evaporation.

Figure 1: Evaporate fraction. R_{chond} and R_{precur} are the radii of chondrule and precursor, respectively.



Concluding Remarks

Our results suggest that it is possible to verify the shock-wave heating model by the measurement of mass-loss fraction as a function of the chondrule radius. Also, the mass-loss fraction may be related to the fractionation between refractory and volatile elements.

References

Miura H. and Nakamoto T., (2003), in preparation.

Identifying silicate minerals incorporated by plants.

T. MIURA,^{1,2} H. IKEDA,¹ F.-F. FU,² D. SUZUKI,² T. AKAGI,¹
AND K. WATANABE²

¹Department of Environmental Science on Biosphere,
Graduate School of Agriculture, Tokyo University of
Agriculture and Technology, Tokyo, Japan
(miura@acl.tokai.jaeri.go.jp) (bububu@cc.tuat.ac.jp)
(akagi@cc.tuat.ac.jp)

²Research Group for Analytical Science, Japan Atomic Energy
Research Institute, Ibaraki, Japan
(fengfu@acl.tokai.jaer.go.jp)
(dsuzuki@analchem.tokai.jaeri.go.jp)
(watanabe@analchem.tokai.jaeri.go.jp)

It has been suggested that presence of higher plants could increase the weathering rates of rocks and minerals. Two mechanisms are commonly known to explain this phenomenon. One is mechanical breakdown of rocks and minerals caused by root elongation. Another is chemical attack following physiological activities of plants. Higher plants can change chemical conditions such as pH and redox condition around their root by excreting organic acids, proton, carbon dioxide, etc., resulting the dissolution of minerals. In any cases, inorganic elements in primary minerals are considered to dissolve into soil solution, and then taken up by plants or flow in drainage.

Recently, however, several studies indicate that some inorganic elements such as rare earth elements, calcium, and potassium in soil solution cannot completely explain the abundance of that in plant's body. This means inorganic elements in primary minerals may be rather directly transported to plants without taking free ionic form or complex form in soil solution.

In order to investigate whether the inorganic elements in plants are derived from primary minerals directly, neodymium isotope ratio provides powerful information. Nd isotope ratio is characteristic of each primary minerals and the value doesn't change during the weathering process and biological activity. The Nd isotope ratio of a plant is determined depending on the mixing proportion of each component from which Nd in the plant is derived.

Several species of plants were sampled from the Strengbach catchment, France. The Strengbach was chosen as sampling area because the age of bedrock was old enough to provide considerable difference between Nd isotope ratio of each minerals. Samples were ashed and digested with nitric acid and hydrofluoric acid. Separation of Nd was done using TRU and LN extraction resin columns. A thermal ionization mass spectrometer (MAT262) was used for the Nd isotope measurement. REEs in the plant specimens were also determined.

The result so far obtained indicate selective uptake of silicate minerals in soils. The present results would possibly affect the interpretation of weathering sequence of silicate minerals and of the REE signature of river water.